

Future Shock: A Conversation with Phil Karn, KA9Q

Amateur Radio's digital revolutionary speaks out on the future of amateur digital communications.

By Rick Booth, KM1G
232 Washington St
Norwood, MA 02062

Phil Karn wants his work to speak for itself, and it does. But a story from his past sheds light on one of ham radio's brightest young minds.

"I remember my mother waking me in the middle of the night," KA9Q confided, "because I'd built this burglar alarm. Neither she nor my dad could turn it off, so they had to wake me. I guess I was about five at the time."

Five years old. He was a quick starter—and he's still going strong. At 33, Phil Karn is a point man in Amateur Radio's press for digital heights, and midwife and attending physician to amateur TCP/IP, the software some say may revolutionize packet radio. Karn received the 1989 Specific Achievement Award at the Dayton HamVention®. His amateur *curriculum vitae* includes director's seats at AMSAT and TAPR, and service on the ARRL Digital Committee. Professionally, he's part of a research group at Bellcore, the R & D arm of the nation's telephone companies. Educated at Cornell and Carnegie-Mellon, he's an electrical engineer who specializes in computers.

Preparing for the interview, I asked people in the digital industry if they'd heard of Phil Karn. Without exception, they had. The typical response was, "Are you *serious*?" Karn and colleagues don't work on today's technology. That's much too tame. They work on the stuff we'll be using *10 years* from now.

He lives a double life of sorts. On the one hand, he's in the loop whose collective thought will take ham radio into the next century: but he's also bridging the gap on the commercial front, which is moving a *lot* faster than ham radio. That alarms Karn's KA9Q persona. Sooner or later, he says, commercial interests coveting our UHF bands will try to expand into those allocations.

Few are better poised to know. He is a

scientist; to him, passion counts little against fact. Karn has argued for a codeless amateur license, to attract tomorrow's digital stars today. In brief: Karn sees the future as digital; digital is bandwidth; and bandwidth means microwaves.

Slights that he is anti-code don't impress him: "I don't hate code. How can I? I have an Extra Class license, so I must have learned it."

But the name of the game, a name he sees getting exponentially stronger, is information transfer. We have traditionally justified our frequency allocations two ways. First, we've always ridden technology's blade. Second, we've always had a powerful voice by virtue

of our emergency response. The recent San Francisco earthquake was but the latest in a long, proud history of *wireless* communication. That's been our forte—when *the wires* go down, from hurricane, earthquake, tornado or flood, we're there. No wires? No problem!

Frankly, Karn indicates, commerce doesn't care. What it *does* care about is information transfer. Technology makes information transfer so efficient, world markets act as one. Money buys better technology, which means faster information, which means more money...

Today, commercial comms lean heavily on hard-line links, as in phone lines. Sure, they



Phil Karn, KA9Q, at his Bellcore office.

What is TCP/IP, Anyway?

If you're not into packet radio (and a lot of hams aren't), why should you care?

The quick answer to question one is that TCP/IP, sometimes just called TCP, is a networking *protocol* that allows talk between computers which otherwise couldn't. And the answer to question two is that TCP/IP may someday revolutionize this hobby. It's that important.

TCP and IP don't work alone. They get top billing on the marquee, but a whole cast of other protocols play a part, depending on the job (electronic mail, for instance; the party needn't be home, just leave a message on their machine. Packet ops have been doing it all along). Together, the package is called a *suite*. "It makes the hardware sort of irrelevant," Karn says. "That doesn't make the hardware companies too happy, but from the user's point of view, it's great."

He's also quick to say he didn't forge TCP/IP's amateur application by himself. Leaps of such magnitude usually carry commensurate complexity, too much for a single mind. Karn's amateur circle includes calls like W3GEY, W3IWI, N4HY and others. The group corresponds regularly by electronic mail, on Internet, which is one model of what they hope to bring into ham radio. Internet's key element is TCP/IP.

Speed and purview are the reasons TCP/IP has swept the commercial world. Karn illustrated with a story about one of the conferences to which he constantly speaks. The conferees were not lightweights: "I was there because I had first-hand knowledge of networking with TCP/IP in

amateur applications on computers like the PC, and even smaller. The guy next to me had used TCP/IP as an interface involving a Cray 2. And we'd both used the same protocol. Not a bad range."

From his front-line foxhole in early packet campaigns, Phil Karn soon saw TCP/IP's amateur applications. He read the literature, and wrote today's ham package. As he's said in published papers, TCP/IP was designed to work in an environment (ours) unthinkable harsh by commercial standards. Commercial systems nearly always use wire links (as Internet does), immune to the open-air threats hams take for granted. Karn credits Mike O'Dell, N4NLN, for saying ham radio wins TCP/IP's "worst wire award."

Did you have friends in San Francisco during its last earthquake? Plenty of us did—just ask Bay-area traffic handlers! Plenty of messages said "Having a wonderful time, wish you were here." But what if the message was ARL One: "Everyone safe here. Please don't worry." It takes on a different hue, doesn't it? It took a couple of days, but a lot of ARL Ones poured across country, thanks to a lot of computers—and a box with a protocol named AX.25.

Phil Karn and his friends see a day when AX.25 gives way entirely to TCP/IP. Harnessing the power of true home computers to ever-faster baud rates with microwave links, the San Francisco messages might have gone through in half the time—or twice the number.

No, you might not care about packet today. But can you be sure about tomorrow?—KM1G

jump oceans by satellite, but the capillaries still reach the heart by twisted pair. How long will that last? The time must come when that's history, and we're right back at Amateur Radio: if commercial links *don't* need land links, but have wireless links instead, who needs the amateur argument? Given our band space, commercial interests could make efficient use until disaster strikes, then use their technology to pass health-and-welfare traffic. It's just one scenario, but a scary one indeed.

Karn ponders such matters at both his office and a little bungalow in Warren, New Jersey, not far from Bellcore in Morristown. He found the place in a newspaper ad. It seemed perfect: a discreet residence, behind the main house, on a narrow, quiet street. Not until he visited the premises did he discover his prospective landlord to be K2QWG. That sealed it, and he's been there about six years.

Outside, the place hardly looks like a single ham lives there, let alone two. There's a tower next to the bungalow, but you can barely see the HF dipole; Karn's not on his ICOM 751 much. The fixed 220 beam gets a workout, though, and so do the computers inside.

A bachelor, Karn lives as he pleases. Bellcore wisely encourages its highly creative brain trust. If inspiration occurs at home—and it often does, at odd hours—so be it; the bungalow has a Sun work station linked to the NSF Internet through Bellcore. The National Science Foundation sponsors the net, which links disparate computers around the globe, keeping Karn in touch with the technical community at colleges and univer-

sities, the defense community, and think tanks like Bellcore. Internet is, among other things, a perfect medium for electronic mail, and Karn gets a lot of it. He is a touch typist ("one of the few useful things I took in high school"), and his fingers flash C language into the Sun at astonishing speed. For amateur work he's relegated to a mere 386 PC with four megs of RAM and an 80-meg hard disk, low-tech for him.

Karn's dream? A well-coordinated coast-to-coast (and beyond) link, where sprinting packets find their destinations without fail. (Subject to operator skill, of course). Technician that he is, Karn accepts the old adage, "garbage in, garbage out," an axiom which transcends mode.

Karn hasn't perfected his ham TCP/IP package down to the last scintilla. "I prefer to build foundations," he said, "and let other people build the rest. When I was writing it, I used the most expedient (programming) means, then went back and cleaned it up."

Not all of the potholes were filled smooth. He's not worried. "I have people ask me to make changes or additions, and I tell them you have the source code, go ahead and do it." He's made many upgrades himself, but he sees a platinum chance for amateurs to make the kind of contribution for which the hobby is justifiably famous.

"Right now, everybody running a BBS is building it right out of their own pocket. The problem is getting all these fiercely independent hams to cooperate." He'd like to see hams temper their independence with cooper-

ation and pooled cash. If available technology can be brought to bear, Karn thinks, a remarkable worldwide packet network based on both terrestrial and satellite links can lend us legitimacy. That, he maintains, translates into efficient spectrum use—and like it or not, efficiency is defined by technology.

The recent FCC blows to the 220-MHz amateur band hit Karn where he lives. KA9Q maintains a permanent packet link on 220.55 MHz with Alfred Shjarback, WB0MPQ. He runs the 386 PC through an Ethernet managed by a stripped-down XT, with no monitor or keyboard. The XT does the packet switching through a high-speed modem and a transverter. The transverter turns 10 meters to 220.55 MHz, where the 56 kbit/s signal goes to WB0MPQ. At the other end, WB0MPQ maintains his own XT-switched 386 permanently on 220.55 MHz, for exchanges with KA9Q. Karn reaches the rest of the packet world through WB0MPQ. His home BBS is NN2Z.

If you've never seen 56 kbit/s transfer, you're missing something. "The (allowed) bandwidth on 220 is 100 kHz," Karn explained, "and at 56 kbit/s, I'm within that. For that matter, the allowable bandwidth on 2 meters is about 20 kHz, and we use it very inefficiently. We could easily go to 9600 (bauds), but few of this generation of TNCs have that."

When it comes to technology, hams as a whole have always been on the wing's leading edge. Phil Karn is hoping we stay there.

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